

Reconsideration and reexamination are respectfully requested.

1. Supplemental Oath, and New Power of Attorney (to Applicant's New Undersigned Representative)

This ammendment is filed under Rule 34(a).

Applicant and sole inventor Hugh Craig will submit the attached supplemental oath and declaration, and combined power of attorney newly to Applicant's undersigned representative, at such time as all amendments have been entered.

Please enter the change of identity, and of address, of Applicant's undersigned representative in the records of the PTO for this application, and address all future communications to Applicant's undersigned representative. Thank you.

2. Status is Now as a Small Entity

The status of the present application is revised to be as a small entity. A verified declaration by the undersigned -- as agent to the Inventor Applicant and holder of all rights in the invention and in the application -- to that effect is attached.

3. Rejections Under 35 U.S.C. §103

Claims 1-39 and 57-67 were rejected under 35 U.S.C. §103(b), for being obvious over the disclosure of U.S. Patent No. 5,376,403 to Capote, et al.

The composition of the present invention will be seen to be patentably distinguished, as claimed, from the composition of Capote, et al., and from all other of the prior art, in that (1) the consituent components of the composition of the present invention are **not** chemically protected, and that (2) the composition of the present invention is **self-catalyzing**. Nonetheless that components are not chemially protected, the composition is insubstantially reactive (substantially

C

nonreactive) at ambient temperature. A resin portion of the composition is cross-linkable by action of a cross-linking agent. However, the cross-linking agent that is part of the composition -- and which usefully has fluxing properties -- will not so serve to cross-link the resin save in the presence of both (i) heat, **and also (ii) catalysis**. Assuming that heat may be applied, how might this catalysis (which leads to enabling the cross-linking agent to cross-link the resin) be realized?

In accordance with the present invention, application of heat to metal and solder powders -- also part of the composition -- ultimately produces a catalyst that serves to effect this catalysis. In the most preferred components, and coaction, of the present invention, this is a two-stage route. The (useful) fluxing reaction of the cross-linking agent removes metal oxide from the metal powders, which becomes a metal salt. It is this metal salt that induces catalysis.

This composition, and this coaction, is neither taught nor suggested by Capote, et al., or other of the reference art, which teach **only** that reactants may be **chemically protected**.

### 3.1 Recapitulation of Applicant's Invention, and It Distinction Over the Prior Art

Before focusing on the language of claims, the indulgence of the Examiner is solicited to recapitulate Applicant's invention, and also to distinguish it over the reference art, in this section 3.1. Thus, by reading of the operation of Applicant's composition, and its distinction from the prior art, the Examiner may later better appreciate the claiming of this distinction within Applicant's (amended) claims.

Applicant's preferred fluxing agent in his composition (now commercially available under the "Polymet" trademark, using resin Jancryl 682) is a polymeric acid containing a reactant. Upon heating to solder reflow temperatures, this polymer becomes more

likely to react with epoxy resins due to increased entropy and a higher range of motion. The resin (Jancryl 682) is indeed reactive to epoxy at ambient temperature, but the rate of reaction is very, very slow due to the material's polymeric nature; namely, that the reactive acid groups are surrounded by large aromatic (styrene) groups. These groups physically hinder the ability of the acid groups to react with the epoxy by act of preventing the reactants to come close enough to react. This effect is called steric hindrance.

Sterically hindered groups are very slow to react at ambient (and at frozen) conditions. But the rate of reaction is increased by any method that increases the degree of freedom and the internal motion of the system, i.e., by heating and/or by solvating. The reactibility of these systems is reversible: that is, a reversion back to the sterically hindered form with no changes in chemistry may be realized by cooling. A chemically blocked or a chemically protected reactant -- such as is taught in the prior art -- is **not** reversible without chemical change.

In the cited references a **chemical** reaction must occur before the chemically protected curing agent will commence to function. Thus reaction -- de-esterification -- occurs as a thermal process, and introduces non-reactive hydroxyl compounds into the resin matrix. This reaction is **not** reversible by removing heat from the system, e.g., cooling. These un-reacted hydroxyl groups undesirably remain in the resin matrix, and can degrade the performance of conductive ink.

The concept of the present invention may be understood to be similar to the concept of premixed and frozen epoxy systems in which the rate of reaction is significantly retarded by freezing which serves to hinder the internal motion, and the entropy, of the system. Upon heating at temperature, these frozen epoxy resins become highly reactive.

The chemistry of the present invention is **not** protected from

C

reaction and is indeed, as stated and as admitted above, proceeding **albeit exceedingly slowly** at ambient temperature. A high rate of reaction does not occur until the **dual conditions** of **both** (i) increased molecular motion (heat) **and** (ii) catalysis are present.

A unique aspect of the present invention is that it is **auto-catalytic**. A catalyst is generated by the reaction of the Jancryl 682 acrylic polymer with metal oxides from the solder powder. The reaction also occurs at ambient temperature, and also during the heating process, but becomes significant only upon melting of the solder metal with permits the metallic oxides to dissolve into the matrix resins and to there serve as a catalyst providing for a high rate of reaction at exactly the right temperature. This characteristic permits the composition of the present invention to function properly not only for tin-lead solder (m.p. 182°C), but also with tin-bismuth solder (m.p. 138°) and the new higher temperature lead free solders demanded for future applications (m.p. 240°C).

A chemically protected cross-linking agent as cited in the references **un-protects** at the de-esterification temperature (approximately 200°C), and would thus be useful primarily only with lead-tin solders (m.p. 180-200°C). These previous agents and compositions will not unblock at the 160°C processing temperature for low-temp tin-bismuth solder, and would likely be totally cured at the temperature necessary to reflow the new high-temp lead-free solders (260°), preventing the sintering of metals.

As still yet another prior art system to which the the concept of Applicant's invention may be compared, consider an admixture of frozen adhesives. The entropy of the system is increased by warming or heating in order that the adhesives may become reactive. This is also the case in Applicant's system and composition: the composition becomes reactive due to higher

C

entropy and molecular motion, **not** by removal of a chemical protecting agent.

### 3.2 Environment of the Claimed Invention

it will be recalled in examination of the claims that the present invention is a composition used to produce metal traces for printed circuit boards, wiring boards and the like. The composition, and the combination circuit board and composition, includes a metal powder, a solder powder and a polymer or a monomer which is polymerisable to yield a polymer, where such polymer being cross-linkable under the action of a chemical cross-linking agent. Furthermore, and importantly, the present invention also includes a chemical cross-linking agent for the polymer, such cross-linking agent having fluxing properties **but** being unreactive with the polymer in the absence of catalysis. The cross-linking agent is a preferably a polyacid, selected from carboxylated polymers, polycarboxylic acids and polymer fatty acids providing multiple reaction sites which lack chemical protection. The claimed composition is stored under conditions such that it does not possess a temperature sufficient for solvating and crosslinking to occur.

Again before focusing on the claim language, the gravamen of Applicant's invention is that his cross-linking agent is substantially **un**reactive at the sites -- nonetheless that these sites lack chemical protection -- and is substantially **non** reactive to the resin, until and unless (i) heat is applied, along with (or, as will be seen to be the case, as is generated), (ii) a catalyst. The cross-linking agent is so nonreactive by stead of being sterically hindered (although this word "sterically" is not used in the specification). (The Examiner will understand that "sterically hindered" means that the molecules simply do not fit together; and that resultant thereto there is not only a difference in some reaction rate, but there

C

is a severely impeded reaction, if any.)

How then **does** reaction occur? Heat applied during a fluxing step causes reaction of the cross-linking agent with the metal oxides, creating metal salts. These metal salts provide the catalysis by which the cross-linking finally transpires! (The Examiner should not look for an exact paraphrase of this paragraph within the claims next considered; the claims are correct, and this paragraph simply expresses the operation of Applicant's claimed composition of matter in a slightly different manner than the claims in order that the Examiner may be sensitized to the explicit limitations of the amended claims, and may better appreciate how these limitations distinguish the claims over the reference art of Capote, et al., and all other.)

### 3.3 Claim 68

Perhaps the simplest claim of Applicant's invention is added claim 68.

It might be noted that this claim **could** have been derived from claim 1 by the following **hypothetical** amendment:

1. (Hypothetically Amended) A composition of matter comprising:

[(a)] a metal powder[,];

[(b)] a solder powder [which melts at lower temperature than the metal powder,];

wherein the metal powder and/or the solder powder under application of heat ultimately produce a catalyst;

[(c)] a polymeric[,] or a monomeric resin [which is polymerisable to yield a polymer, said polymer being] cross-linkable under the action of a [chemical] cross-linking agent,

[(d)] a polymeric cross-linking agent for said [polymer] resin, the cross-linking [agent being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids so as to provide multiple reaction sites, the cross-linking agent having fluxing properties and being nonreactive with said polymer without the application of heat and provision of a catalyst for reaction therebetween, the cross-linking agent, a such, not reacting with said polymer under storage conditions, and the cross-linking agent being capable of solvating

(e) metallic oxide and metallic salt catalysts which are formed by heating metallic components (a) and (b) and which promote a rapid cross-linking reaction between said polymer (c) and said cross-linking agent (d) when incorporated in said polymer, as a result of solvation by the cross-linking agent in the presence of heat.]

having fluxing properties, and  
being by nature of its polymeric form unreactive  
with the resin without heat and catalysis;  
wherein the produced catalyst catalyzes cross-linking  
of the resin by the polymeric cross-linking agent; and  
wherein the composition is self-catalyzing, the  
polymeric cross-linking agent producing on application of  
heat the catalyst that serves to catalyze the cross-linking  
of the resin.

Therefore added claim 1 is different, but not inconsistent with, claim 1 to which the Examiner has already been exposed.

Claim 68 is patentably distinct over all the art of reference for, inter alia, claiming such constituent parts, and such properties of these parts, as do, in concert, make a "composition [that is] is self-catalyzing, the polymeric cross-linking agent producing on application of heat the catalyst that serves to catalyze the cross-linking of the resin" (claim 68).

#### 3.4 Claims 1-19, 21-22, 24-39 and 57-67

Having studied claim 68, the patentable limitations of the other claims should now be identifiable by the Examiner.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. V. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Stizziki Motor Co.*, 868 F2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

The Examiner has rejected all of the claims under 35 U.S.C. 10#(b), contending that the claims are obvious over the disclosure of U.S. Patent No. 5,376,403 to Capote, et al. In so

C'

doing, the Examiner has contended that since Capote, et al., disclose electrically conductive adhesive compositions and methods for their preparation which include a solder powder, a chemically protected cross-linking agent with fluxing properties and a reactive monomer or polymer, the reference discloses and clearly anticipates every claim.

Applicant respectfully disagree with the Examiner's analysis, and requests reconsideration of the claims and allowance based on the amendments to the claims and the analysis set forth herein.

Consider second-amended claim 1. The compositions must be compared in their storage condition. In that regard, U.S. Patent No. 5,376,403 to Capote, et al. discloses an electrically conductive adhesive composition which includes a solder powder and a **chemically protected** cross-linking agent which also later serves as a fluxing agent. This disclosure does not teach nor suggests the chemical composition of the present invention. Capote, et al. require as an essential feature the use of a chemically protected cross-linking agent, with fluxing properties upon heating. The Capote, et al. cross-linking agent is **chemically protected** to ensure that it cannot act as cross-linking agent under, for example, storage conditions. Not only is this disclosure not anticipatory of the present invention, it actually teaches away from the present invention.

In the present invention, a polymer or monomer which is polymerisable to yield a polymer can be crosslinked under the action of a chemical cross-linking agent. The cross-linking agent of the present invention is **unprotected** chemically -- yet it is nonreactive with the polymer in the absence of the application of heat and catalysis. This is **contrary** to the disclosure and the teachings of the Capote, et al. reference!

To that end, the cross-linking agents of the present invention are polyacid in nature and are selected from



carboxylated protection are a substantial part of the adhesive, and their presence affects the processing and effects the performance of the product made from the Capote, et al. composition. Furthermore, the additional heating requirements promote the formation of intermetallic compositions known to degrade the performance of electrical conductors and interconnects by both increasing the resistance to current flow and embrittling the trace. Such problems have been surmounted using the compositions of the present invention.

The present system is quite contrary to the Capote, et al. teaching in that there is no requirement for chemical deprotection as required by Capote, et al. The only mention of a carboxylic compound in connection with a cross-linking agent by Capote, et al. has to do with esterified carboxyl groups of relatively low molecular weight compounds which must be de-esterified during processing. As clearly described above, this leads to an inferior product which cannot be processed as simply as the claimed composition, nor does the Capote, et al. composition operate electrically as efficiently as the present invention.

In order to emphasize the distinction over carboxylic acids which have been esterified, the independent claims have been amended to clearly indicate that the reaction sites on the cross-linking agent lack chemical protection.

#### 4. Summary

The present amendment and remarks have overcome and discussed each of the bases for the rejections presented in the Office Action. No new subject matter has been introduced by the present amendment.

In consideration of the preceding amendment and accompanying remarks, the present application is deemed in condition for allowance. The timely action of the Examiner to that end is

C

Serial No.: 09/242,388  
Page 11

earnestly solicited.

Applicant's undersigned attorney is at the Examiner's disposal should the Examiner wish to discuss any matter which might expedite prosecution of this case.

Sincerely yours,

*William C. Fuess*

William C. Fuess  
Registration Number 30,054

FUESS & DAVIDENAS  
Attorneys-at-Law  
10951 Sorrento Valley Road  
Suite II-G  
San Diego, California 92121-1613  
Telephone: (858) 452-8293  
Facsimile: (858) 452-6035  
E-mail: fuess@pacbell.net

William C. Fuess  
☐ Attorney of Record  
☒ Filed Under 37 CFR §1.34(a)

---

**CERTIFICATE OF MAILING**

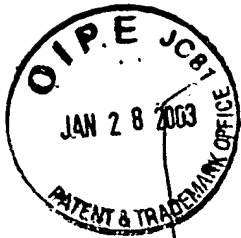
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on the date written below.

January 17, 2003  
Date

William C. Fuess  
Typed Name of Person  
Mailing Correspondence

*William C. Fuess*  
Signature of Person Mailing  
Correspondence

C



CLAIMS IN PLAIN TEXT FORM

RECEIVED  
JAN 30 2003  
TC 1700

1. (Twice Amended) A composition of matter comprising:
- (a) a metal powder,
  - (b) a solder powder which melts at lower temperature than the metal powder,
  - (c) a polymer, or a monomer which is polymerisable to yield a polymer, said polymer being crosslinkable under the action of a chemical cross-linking agent,
  - (d) a cross-linking agent for said polymer, the cross-linking agent being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids so as to provide multiple reaction sites which lack chemical protection, the cross-linking agent having fluxing properties and being substantially nonreactive at said sites with said polymer without the application of heat and provision of a catalyst for reaction therebetween, the cross-linking agent not reacting with said polymer under storage conditions, and the cross-linking agent being capable of solvating,
  - (e) metallic oxide and metallic salt catalyst which are formed by heating metallic components (a) and (b) and which promote a rapid cross-linking reaction between said polymer (e) and said cross-linking agent (d) when incorporated in said polymer, as a result of solvation of said catalyst by the cross-linking agent in the presence of heat, said composition being under storage conditions such that it does not possess a temperature sufficient for such solvating and crosslinking reaction to occur.

2. (Restated) A composition according to claim 1 wherein said metal powder is selected from Au, Ag, Cu, Zn, Al, Pd, Pt, Rh, Fe, Ni, Co, Mo, W, Be, and alloys thereof.

3. (Restated) A composition according to claim 2 wherein said metal powder is copper.

4. (Amended) A composition according to claim 1 wherein said solder powder is selected from Sn, Bi, Pb, Cd, Zn, Ga, In, Te, Hu, Sb, Tl and alloys thereof.

5. (Restated) A composition according to claim 1 wherein said solder powder is Sn63Pb37.

6. (Amended) A composition according to claim 1 wherein said cross-linking agent is selected from carboxylated polymers, dimer fatty acids and trimer fatty acids.

7. (Restated) A composition according to claim 6 wherein said cross-linking agent is a styrene-acrylic acid copolymer, and/or an organic trimer acid, having a functionality greater than 1.

8. (Amended) A composition according to claim 1 wherein said catalyst is formed by heating and oxidation of solder powder and dissolved by a fluxing agent.

9. (Amended) A composition according to claim 8 wherein said catalyst is metallic oxide catalyst formed by heating and oxidation of tin and/or lead powder and dissolved by a fluxing agent.

10. (Amended) A composition according to claim 1 wherein said catalyst is a metallic salt catalyst formed by heating and oxidation of tin and/or lead powder and dissolved by a fluxing agent.

11. (Restated) A composition according to claim 10 wherein said catalyst is a tin salt catalyst formed by heating tin to form a tin oxide and reaction of the later with resin or solvent to produce a tin salt.

12. (Restated) A composition according to claim 10 wherein said catalyst is a copper salt catalyst formed by heating copper to form a copper oxide and reaction of the later with resin or solvent to

produce a tin salt.

13. (Amended) A composition according to claim 1 wherein an organic chelating agent is adhered to the metal powder as stability enhancer and the organic chelating agent is decomposes at solder melting temperature to provide decomposition products which dissolve in the fluxing agent as additional catalyst for the chemical cross-linking agent.

14. (Restated) A composition according to claim 13 wherein said organic chelating agent is an azole chelating agent.

15. (Restated) A composition according to claim 13 wherein said organic chelating agent is benzotriazole.

C2 16. (Amended) A composition according to claim 1, further comprising a copper salt deactivator as a stability enhancer.

17. (Restated) A composition according to claim 16 wherein said copper salt deactivator is oxayl bis benzxylidene.

18. (Twice Amended) A composition for application to a dielectric substrate a predetermined pattern and comprising, in admixture

(i) a metallic powder component which includes (a) a solder powder and (b) a metal powder melting at a higher temperature than the solder powder,

C3 (ii) a polycarboxyl compound effective as a fluxing agent for the metallic powder component at a first elevated temperature and as a cross-linking agent for an epoxy resin at a higher second temperature, the polycarboxyl compound being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids providing multiple reaction sites which lack chemical protection, and

(iii) an epoxy resin, which composition is at a temperature below said first elevated temperature.

19. (Twice Amended) A composition comprising in admixture:

(i) a metallic powder component which includes (a) a solder powder and (b) a metal powder melting at a higher temperature than the solder powder;

(ii) a polycarboxyl compound effective as a fluxing agent for the metallic powder component at a first elevated temperature and as a cross-linking agent for an epoxy resin at a higher second temperature, the polycarboxyl compound being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids providing multiple reaction sites which lack chemical protection, the composition being applied to a dielectric substrate to which an epoxy resin has been pre-applied, the composition thus applied being at a temperature below said first elevated temperature.

21. (Amended) A composition according to claim 19, wherein the epoxy resin is printed on the substrate in a predetermined pattern.

22. (Amended) A composition according to claim 18, wherein the polycarboxyl compound is thermally stable to 215°C and has an acid number greater than 200 and a viscosity less than 0.01 Pa.s (10 centipoise) at 200°C.

24. (Amended) A composition according to claim 18, wherein the polymer fatty acid is a dimer or trimer fatty acid.

25. (Amended) A composition according to claim 18, wherein the polycarboxyl carboxylated polymer is a styrene-acrylic acid copolymer.

26. (Amended) A composition according to claim 18, wherein the metal powder component contains up to 90% by weight of the metal powder (b) and from <100 to 10% by weight of the solder powder.

27. (Amended) A composition according to claim 18, wherein metal powder (b) is selected from Au, Ag, Cu, Zn, Al, Pd, Pt, Rh, Fe, Ni,

Co, Mo, W, Be, and alloys thereof.

28. (Amended) A composition according to claim 18, wherein solder powder is selected from Sn, Bi, Pb, Cd, Zn, Ga, In, Te, Hu, Sb, Tl and alloys thereof.

29. (Amended) A composition according to claim 18, wherein the solder powder includes a first metal and a second metal, the first metal having an affinity for the high melting point constituent, an oxide of the second metal being a catalyst for the curing of the epoxy resin and the first and second metals being melted together to form a metal film in which is embedded particles of the high melting point constituent while the first and second molten metals form a matrix on regions between the particles of the high melting point constituent, which matrix is rich in the second metal of the relatively low melting point constituent.

~~26 30.~~ (Amended) A composition according to claim 18, wherein the solder powder is a tin/lead alloy.

C 4 27 ~~31.~~ (Amended) A composition according to claim 18, wherein the metal powder (b) is copper.

32. (Amended) A composition according to claim 18, wherein the chelation agent is benzotiazole.

33. (Second Amended) A composition according to claim 18, wherein the epoxy resin consists essentially of an epoxy resin that is liquid at ambient temperature.

34. (Second Amended) A composition according to claim 18, which contains, in percent by weight, from 5 to 50% in total of epoxy resin and polycarboxyl compound and 95 to 50% by weight the metallic powder component.

35. (Amended) A composition according to claim 18 wherein the

metal powder (b) is a copper powder which has been cleaned and coated with a stability enhancing copper deactivator which is a chelation agent for the copper and a high temperature catalyst for the crosslinking of the epoxy resin.

36. (Amended) A composition according to claim 35, wherein the chelation agent is an azole compound.

C05 <sup>33</sup>37. (Amended) A composition according to claim <sup>32</sup>~~36~~ wherein the chelation agent is benzotriazole.

38. (Amended) A composition according to claim 18, wherein the metal powder (b) is a copper powder and the composition additionally includes anti-oxidant copper deactivating agent.

C06 <sup>35</sup>39. (Amended) A composition according to claim 18, wherein metal powder is copper powder and the composition additionally includes oxalyl bis benzylidene hydrazine as the anti-oxidant copper deactivating agent.

<sup>38</sup>57. (New) A composition according to claim <sup>36</sup>~~19~~, wherein the polycarboxyl compound is thermally stable to 215°C and has an acid number greater than 200 and a viscosity less than 0.01 Pas (10 centipoise) at 200°C.

<sup>39</sup>58. (New) A composition according to claim <sup>36</sup>~~19~~, wherein the polymer fatty acid is a dimer or trimer fatty acid.

C07 <sup>40</sup>59. (New) A composition according to claim <sup>36</sup>~~19~~, wherein the carboxylated polymer is a styrene-acrylic acid copolymer.

<sup>41</sup>60. (New) A con-position according to claim <sup>36</sup>~~19~~, wherein the metal powder component contains up to 90% by weight of metal powder (b) and from <100 to 10% by weight of the solder powder.

<sup>42</sup>61. (New) A composition according to claim <sup>36</sup>~~19~~, wherein metal



powder (b) is a metal selected from Au, Ag, Cu, Zn, Al, Pd, Pt, Rh, Fe, Ni, Co, Mo, W, Be, and alloys thereof.

<sup>43</sup>  
~~62.~~ (New) A composition according to claim <sup>36</sup>~~19~~, wherein the solder powder is selected from Sn, Bi, Pb, Cd, Zn, Ga, In, Te, Hu, Sb, Tl and alloys thereof.

<sup>44</sup>  
~~63.~~ (New) A composition according to claim <sup>36</sup>~~19~~, wherein the solder powder is a tin/lead alloy.

<sup>45</sup>  
~~64.~~ (New) A composition according to claim <sup>36</sup>~~19~~, wherein the metal powder (b) is copper.

<sup>46</sup>  
~~65.~~ (New) A composition according to claim <sup>36</sup>~~19~~, wherein the metallic powder component has particles of a size less than 25  $\mu\text{m}$ .

C7  
cont'd  
<sup>47</sup>  
~~66.~~ (New) A composition according to claim <sup>36</sup>~~19~~, wherein the metal powder (b) is copper powder and the composition additionally includes an anti-oxidant copper deactivating agent.

<sup>48</sup>  
~~67.~~ (New) A composition according to claim <sup>36</sup>~~19~~, wherein the metal powder is copper powder and the composition additionally includes oxalyl bis benzyldene hydrazine as an anti-oxidant copper deactivating agent.

<sup>49</sup>  
~~68.~~ (New) A composition of matter comprising:  
a metal powder;  
a solder powder;  
wherein the metal powder and/or the solder powder under application of heat ultimately produce a catalyst;  
a polymeric or a monomeric resin cross-linkable under the action of a cross-linking agent,  
a polymeric cross-linking agent for said resin, the cross-linking  
having fluxing properties, and  
being by nature of its polymeric form unreactive with the

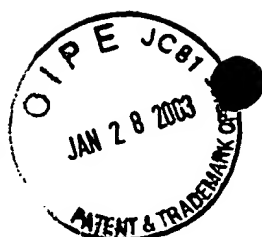
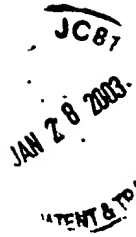
resin without heat and catalysis;

wherein the produced catalyst catalyzes cross-linking of the resin by the polymeric cross-linking agent; and

wherein the composition is self-catalyzing, the polymeric cross-linking agent producing on application of heat the catalyst that serves to catalyze the cross-linking of the resin.

---

C7  
contg



CLAIMS IN AMENDED FORM

RECEIVED

JAN 30 2003

TC 1700

1. (Twice Amended) A composition of matter comprising:
  - (a) a metal powder,
  - (b) a solder powder which melts at lower temperature than the metal powder,
  - (c) a polymer, or a monomer which is polymerisable to yield a polymer, said polymer being crosslinkable under the action of a chemical cross-linking agent,
  - (d) a cross-linking agent for said polymer, the cross-linking agent being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids [providing] so as to provide multiple reaction sites which lack chemical protection, the cross-linking agent having fluxing properties and being substantially nonreactive at said sites with said polymer without the application of heat and provision of a catalyst for reaction therebetween, the cross-linking agent[, as such,] not reacting with said polymer under storage conditions, and the cross-linking agent being capable of solvating,
  - (e) metallic oxide and metallic salt catalyst[s] which are formed by heating metallic components (a) and (b) and which promote a rapid cross-linking reaction between said polymer (e) and said cross-linking agent (d) when incorporated in said polymer, as a result of solvation of said catalyst by the cross-linking agent in the presence of heat, said composition being under storage conditions such that it does not possess a temperature sufficient for such solvating and crosslinking reaction to occur.
2. (Restated) A composition according to claim 1 wherein said metal powder is selected from Au, Ag, Cu, Zn, Al, Pd, Pt, Rh, Fe, Ni, Co, Mo, W, Be, and alloys thereof.
3. (Restated) A composition according to claim 2 wherein said metal powder is copper.

C

4. (Amended) A composition according to claim 1 wherein said solder powder is selected from Sn, Bi, Pb, Cd, Zn, Ga, In, Te, Hu, Sb, Tl and alloys thereof.

5. (Restated) A composition according to claim 1 wherein said solder powder is Sn63Pb37.

6. (Amended) A composition according to claim 1 wherein said cross-linking agent is selected from carboxylated polymers, dimer fatty acids and trimer fatty acids.

7. (Restated) A composition according to claim 6 wherein said cross-linking agent is a styrene-acrylic acid copolymer, and/or an organic trimer acid, having a functionality greater than 1.

8. (Amended) A composition according to claim 1 wherein said catalyst is formed by heating and oxidation of solder powder and dissolved by [the] a fluxing agent.

9. (Amended) A composition according to claim 8 wherein said catalyst is metallic oxide catalyst formed by heating and oxidation of tin and/or lead powder and dissolved by [the] a fluxing agent.

10. (Amended) A composition according to claim 1 wherein said catalyst is a metallic salt catalyst formed by heating and oxidation of tin and/or lead powder and dissolved by [the] a fluxing agent.

11. (Restated) A composition according to claim 10 wherein said catalyst is a tin salt catalyst formed by heating tin to form a tin oxide and reaction of the later with resin or solvent to produce a tin salt.

12. (Restated) A composition according to claim 10 wherein said catalyst is a copper salt catalyst formed by heating copper to form a copper oxide and reaction of the later with resin or solvent to

produce a tin salt.

13. (Amended) A composition according to claim 1 wherein an organic chelating agent is adhered to the metal powder as stability enhancer and the organic chelating agent is decomposes at solder melting temperature to provide decomposition products which dissolve in the fluxing agent as additional catalyst for the chemical cross-linking agent.

14. (Restated) A composition according to claim 13 wherein said organic chelating agent is an azole chelating agent.

15. (Restated) A composition according to claim 13 wherein said organic chelating agent is benzotriazole.

16. (Amended) A composition according to [any preceding] claim 1, further comprising a copper salt deactivator as a stability enhancer.

17. (Restated) A composition according to claim 16 wherein said copper salt deactivator is oxalyl bis benzylidene.

18. (Twice Amended) A composition for application to a dielectric substrate a predetermined pattern and comprising, in admixture

(i) a metallic powder component which includes (a) a solder powder and (b) a metal powder melting at a higher temperature than the solder powder,

(ii) a polycarboxyl compound effective as a fluxing agent for the metallic powder component at a first elevated temperature and as a cross-linking agent for an epoxy resin at a higher second temperature, the polycarboxyl compound being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids [so as to provide] providing multiple reaction sites which lack chemical protection, and

(iii) an epoxy resin, which composition is at a temperature below said first elevated temperature.

C

- 34 19. (Twice Amended) A composition comprising in admixture:
- (i) a metallic powder component which includes (a) a solder powder and (b) a metal powder melting at a higher temperature than the solder powder;
  - (ii) a polycarboxyl compound effective as a fluxing agent for the metallic powder component at a first elevated temperature and as a cross-linking agent for an epoxy resin at a higher second temperature, the polycarboxyl compound being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids [so as to provide] providing multiple reaction sites which lack chemical protection, the composition being applied to a dielectric substrate to which an epoxy resin has been pre-applied, the composition thus applied being at a temperature below said first elevated temperature.
- 37 21. (Amended) A composition according to claim 19, wherein the epoxy resin is printed on the substrate in a predetermined pattern.
- 19 22. (Amended) A composition according to claim 18, wherein the polycarboxyl compound is thermally stable to 215°C and has an acid number greater than 200 and a viscosity less than 0.01 Pa.s (10 centipoise) at 200°C.
- 20 24. (Amended) A composition according to claim 18, wherein the polymer fatty acid is a dimer or trimer fatty acid.
- 21 25. (Amended) A composition according to claim 18, wherein the polycarboxyl carboxylated polymer is a styrene-acrylic acid copolymer.
- 22 26. (Amended) A composition according to claim 18, wherein the metal powder component contains up to 90% by weight of the metal powder (b) and from <100 to 10% by weight of the solder powder.
- 23 27. (Amended) A composition according to claim 18, wherein metal powder (b) is selected from Au, Ag, Cu, Zn, Al, Pd, Pt, Rh, Fe, Ni,

Co, Mo, W, Be, and alloys thereof.

- 24 ~~28~~. (Amended) A composition according to claim 18, wherein solder powder is selected from Sn, Bi, Pb, Cd, Zn, Ga, In, Te, Hu, Sb, Tl and alloys thereof.
- 25 ~~29~~. (Amended) A composition according to claim 18, wherein the solder powder includes a first metal and a second metal, the first metal having an affinity for the high melting point constituent, an oxide of the second metal being a catalyst for the curing of the epoxy resin and the first and second metals being melted together to form a metal film in which is embedded particles of the high melting point constituent while the first and second molten metals form a matrix on regions between the particles of the high melting point constituent, which matrix is rich in the second metal of the relatively low melting point constituent.
- 26 ~~30~~. (Amended) A composition according to claim [29] 18, wherein the solder powder is a tin/lead alloy.
- 27 ~~31~~. (Amended) A composition according to claim [29] 18, wherein the metal powder (b) is copper.
- 28 ~~32~~. (Amended) A composition according to claim 18, wherein the chelation agent is benzotiazole.
- 29 ~~33~~. (Second Amended) A composition according to claim 18[;], wherein the epoxy resin consists essentially of an epoxy resin that is liquid at ambient temperature.
- 30 ~~34~~. (Second Amended) A composition according to claim 18[;], which contains, in percent by weight, from 5 to 50% in total of epoxy resin and polycarboxyl compound and 95 to 50% by weight the metallic powder component.
- 31 ~~35~~. (Amended) A composition according to claim 18 wherein the

metal powder (b) is a copper powder which has been cleaned and coated with a stability enhancing copper deactivator which is a chelation agent for the copper and a high temperature catalyst for the crosslinking of the epoxy resin.

32 ~~36~~. (Amended) A composition according to claim 35, wherein the chelation agent is an azole compound.

33 ~~37~~. (Amended) A composition according to claim [35] 36 wherein the chelation agent is benzotriazole.

34 ~~38~~. (Amended) A composition according to claim 18, wherein the metal powder (b) is a copper powder and the composition additionally includes anti-oxidant copper deactivating agent.

35 ~~39~~. (Amended) A composition according to claim [38] 18, wherein metal powder is copper powder and the composition additionally includes oxalyl bis benzyldiene hydrazine as the anti-oxidant copper deactivating agent.

36 ~~57~~. (New) A composition according to claim 19, wherein the polycarboxyl compound is thermally stable to 215°C and has an acid number greater than 200 and a viscosity less than 0.01 Pas (10 centipoise) at 200°C.

37 ~~58~~. (New) A composition according to claim 19, wherein the polymer fatty acid is a dimer or trimer fatty acid.

40 ~~59~~. (New) A composition according to claim 19, wherein the carboxylated polymer is a styrene-acrylic acid copolymer.

41 ~~60~~. (New) A con-position according to claim 19, wherein the metal powder component contains up to 90% by weight of metal powder (b) and from <100 to 10% by weight of the solder powder.

42 ~~61~~. (New) A composition according to claim 19, wherein metal



powder (b) is a metal selected from Au, Ag, Cu, Zn, Al, Pd, Pt, Rh, Fe, Ni, Co, Mo, W, Be, and alloys thereof

43 62. (New) A composition according to claim 19, wherein the solder powder is selected from Sn, Bi, Pb, Cd, Zn, Ga, In, Te, Hu, Sb, Tl and alloys thereof

44 63. (New) A composition according to claim 19, wherein the solder powder is a tin/lead alloy.

45 64. (New) A composition according to claim 19, wherein the metal powder (b) is copper.

46 65. (New) A composition according to claim 19, wherein the metallic powder component has particles of a size less than 25  $\mu\text{m}$ .

47 66. (New) A composition according to claim 19, wherein the metal powder (b) is copper powder and the composition additionally includes an anti-oxidant copper deactivating agent.

48 67. (New) A composition according to claim 19, wherein the metal powder is copper powder and the composition additionally includes oxalyl bis benzyldiene hydrazine as an anti-oxidant copper deactivating agent.

49 68. (New) A composition of matter comprising:  
a metal powder;  
a solder powder;  
wherein the metal powder and/or the solder powder under application of heat ultimately produce a catalyst;  
a polymeric or a monomeric resin cross-linkable under the action of a cross-linking agent,  
a polymeric cross-linking agent for said resin, the cross-linking  
having fluxing properties, and  
being by nature of its polymeric form unreactive with the

resin without heat and catalysis;

wherein the produced catalyst catalyzes cross-linking of the resin by the polymeric cross-linking agent; and

wherein the composition is self-catalyzing, the polymeric cross-linking agent producing on application of heat the catalyst that serves to catalyze the cross-linking of the resin.